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with. It is a recognition of good work well done that is due to him, an inspiration to his successors and an incentive to those who are just entering upon public service. We will never see the time when public office will bring the income that private business affords, but we can strive with some hope of success to secure for those who discharge public duties ably and constructively a permanent recognition of what they do. The character of the works used in water supply particularly adapts them for receiving memorial tablets commemorating the services of these able men.

John M. Goodell.

THE RELATION OF COLLOIDS TO WATER PURIFICATION AND SEWAGE DISPOSAL

The colloidal state of matter is a subject that has received considerable attention from scientists during the last decade, but the application of the laws established by research to practical problems has been far too limited. The extremely broad field to which the study of this subject is applicable may be perhaps some excuse for the slow advance, but it is probably also due to the lack of contact, and possibly interest, which the research worker usually has in applied science. To those who are so fortunate as to have a good working knowledge of the fundamentals of colloidal phenomena and physical chemistry in general, and who also are confronted with practical problems in which this knowledge may be utilized, the opportunities for contributing to the advancement of the arts are unparalleled. In agriculture, medicine, sanitation and hundreds of industries, many of the unsolved problems are those relating to matter in the colloidal state.

In the field of water purification and of sewage disposal, there is a great need for an intelligent application of the principles involved in colloidal chemistry. We know far too little why some turbid waters are more easily coagulated than others. We know comparatively little of the inhibitory effects which various substances and chemicals may have in preventing effective coagulation of suspensoids. We have only a limited and decidedly empirical knowledge of the influence of temperature upon coagulation of natural waters.

In water softening we are confronted with several problems in which colloidal and physical chemistry must eventually provide the practical solution. For example, how may the precipitation of calcium salts be hastened where caustic lime alone, or the latter together with soda ash are used; how may the sludge from such plants be best utilized in the freshly treated raw water to facilitate these reactions; how are the solubilities of the calcium and magnesium carbonates and of magnesium hydroxide affected by the presence of other salts in solution, and how much actual effect does the temperature of the water have on the chemical reactions taking place and the physical changes which follow the latter? The answer to these questions must be found in a knowledge of the solubility products of the salts and compounds in question; in the laws relating to equilibrium which must exist between dissociated and undissociated compounds, and between undissociated compounds and the precipitated solids; in the nature and effect of surface tension; in the phenomenon of adsorption, and in the velocity of chemical reactions.

The unsolved problem in sewage disposal is what to do with the sludge. The physical condition of this residual matter varies, of course, with the process employed; but in every case the sludge is colloidal in character, and its manipulation is made difficult by all of those properties which are inherent to colloids. The problem is much more difficult where trade wastes are involved. In the latter we have oftentimes gelatinous material of the most offensive type and which, because of its colloidal condition, does not yield to any form of treatment to which it may be reasonably subjected.

Structures cannot be intelligently designed and built for treating water and sewage unless the principles which govern the changes in the solid and liquid substances contained in them are understood. If these principles are still undiscovered, then we must resort to experimental studies, and base our designs on more or less empirical formulas. Nevertheless, this lack of knowledge is no reason for not using that which is available, and endeavoring to apply in practice what is now known. Imitation and rule of thumb do not advance the art of engineering. Many chemists have but a hazy idea of colloidal and physical chemistry, and to the average engineer the terminology of the subject is practically unknown.

J. W. Ellms.